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DIAGNOSTICS AND MODELING OF ENTERPRISE ECONOMIC PROCESSES

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ДІАГНОСТИКА ТА МОДЕЛЮВАННЯ ЕКОНОМІЧНИХ ПРОЦЕСІВ ПІДПРИЄМСТВА

The modern development of the economy has entered a phase characterized by the dynamic nature of internal and external economic processes that determine the functioning and development of contemporary enterprises. In fact, digitalization, automation, and the implementation of innovative technologies are transforming the ways production, management, and internal communication are carried out within enterprises, thereby accelerating internal processes. The continuous growth in the number of market participants forces enterprises to adapt quickly, optimize resources, and respond to market fluctuations. This variability requires such entities to be able to timely identify problems and assess the efficiency of enterprise operations, which is ensured through comprehensive diagnostics and modeling of economic processes. Accordingly, the purpose of this article is to study methods for diagnosing and modeling the economic processes of an enterprise in order to improve the effectiveness of managerial decision-making. It is substantiated that the application of a set of diagnostic methods (financial analysis, economic and statistical methods, and expert assessments) ensures the formation of an objective information base for managerial decisions, while

methods of modeling economic processes (analytical, mathematical, simulation, and computer modeling) make it possible to reproduce the enterprise's economic processes, forecast the consequences of managerial actions, and optimize resource utilization. In the course of the study, it was established that combining diagnostics and modeling into a unified methodological system improves the quality of management of an enterprise's economic processes by ensuring the timely identification of problem areas, assessment of internal development reserves, and the formation of alternative managerial decision scenarios. It has been proven that the comprehensive application of these methods contributes to increasing the enterprise's adaptability to changes in the external environment, reducing managerial risks, and enhancing the efficiency of financial and economic activities. The findings can be applied in the management of enterprises across various industries to improve systems of economic analysis, strategic and operational planning, and may also serve as a basis for further research on developing integrated models for diagnosing and modeling an enterprise's economic processes.

Сучасний розвиток економіки увійшов у фазу динамічності внутрішніх та зовнішніх економічних процесів, які зумовлюють функціонування та розвиток сучасного підприємства. Цифровізація, автоматизація та впровадження інноваційних технологій трансформують наявні способи виробництва, управління та комунікації, прискорюючи внутрішні процеси підприємства. Постійне зростання числа учасників ринку змушує підприємства швидко адаптуватися, оптимізувати ресурси та реагувати на ринкові коливання. Окреслена змінність вимагає від таких суб'єктів здатності своєчасно виявляти проблеми та оцінювати ефективність діяльності підприємства, що забезпечується через комплексну діагностику та моделювання економічних процесів. Відтак, метою даної статті є дослідження методів діагностики та моделювання економічних процесів підприємства з метою підвищення ефективності управлінських рішень.

Обґрунтовано, що застосування сукупності методів діагностики (фінансового аналізу, економіко-статистичних та експертних) забезпечує формування об'єктивної інформаційної бази для прийняття управлінських рішень, тоді як методи моделювання економічних процесів (аналітичне, математичне, імітаційне та комп'ютерне моделювання) дозволяють відтворювати економічні процеси підприємства, прогнозувати наслідки управлінських впливів та оптимізувати використання ресурсів. Встановлено, що інтеграція діагностики та моделювання в єдину методологічну систему підвищує якість управління економічними процесами підприємства, забезпечуючи своєчасне виявлення проблемних ділянок, оцінку внутрішніх резервів розвитку та формування альтернативних сценаріїв управлінських рішень. Доведено, що комплексне застосування зазначених методів сприяє підвищенню адаптивності підприємства до змін зовнішнього середовища, зниженню рівня управлінських ризиків та зростанню ефективності фінансово-господарської діяльності. Отримані результати можуть бути використані в практиці управління підприємствами для вдосконалення системи економічного аналізу, стратегічного та оперативного планування, а також послугувати підґрунтям для подальших наукових досліджень у напрямі розробки інтегрованих моделей діагностики та моделювання економічних процесів підприємства.

Keywords: *variability; managerial decision-making; analytical modeling; mathematical modeling; simulation and computer modeling; diagnostics; process.*

Ключові слова: *змінність; прийняття управлінських рішень; аналітичне моделювання; математичне моделювання; імітаційне та комп'ютерне моделювання; діагностика; процес.*

Problem statement. The modern economy has entered a phase characterized by dynamic internal and external processes that shape the functioning and development of contemporary enterprises. In practice, digitalization, automation,

and the adoption of innovative technologies are transforming production methods, management practices, and internal communications, accelerating operational processes. The continual growth in market participants forces companies to adapt quickly, optimize resources, and respond effectively to market fluctuations. This dynamic environment requires enterprises to identify problems promptly and assess their operational efficiency—an objective achieved through comprehensive diagnostics and modeling of economic processes. For example, a manufacturing company implementing a digital monitoring system for its production lines can track equipment performance, material usage, and product quality in real time. By modeling these processes, management can forecast the potential consequences of changes in technological parameters, optimize production schedules, and respond promptly to deviations, thereby improving overall efficiency.

Through the diagnostics of economic processes, management gains objective insights into the enterprise's financial condition, resource utilization efficiency, and growth potential. This information enables informed decision-making, enhances competitiveness, and ensures sustainable development in a constantly changing economic landscape.

Thus, the scientific interest in this issue stems from the need to develop methods that combine analytical assessment of an enterprise's condition with modeling tools to support well-founded strategic decision-making. Research in this area not only enhances the economic efficiency of individual enterprises but also contributes to the overall development of the national economy amid ongoing market transformations.

Analysis of research and publications. The issues of designing and adjusting an enterprise's economic processes have been studied by scholars such as Ughulu J. [4], Schulte S., Janiesch C., Venugopal S., Weber I., Hoenisch P. [5], Stanislavyk O., Kovalenko O., and Zhao J. [6]. In particular, these researchers examine the formalization and optimization of economic processes, the application of digital technologies in their modeling, the use of analytical and simulation process models to support managerial decision-making, as well as methods for adapting an

enterprise's economic processes to changes in the external environment and conditions of uncertainty.

At the same time, systematic research on methods for diagnosing and modeling an enterprise's economic processes remains underdeveloped, resulting in fragmented approaches and limiting the potential for a comprehensive justification of managerial decisions.

Furthermore, Shmatkovska T., Dzyamulich M., and Stashchuk O. [7], in their research on current issues in business process modeling, directly note that most studies focus on individual tools or specific aspects of analysis. In contrast, the integration of diagnostic and modeling methods into a unified methodological framework requires further scholarly attention.

Formulation of the article's objectives. Accordingly, the purpose of this article is to study methods for diagnosing and modeling the economic processes of an enterprise to improve the effectiveness of managerial decision-making.

The paper main body. Within the scope of this study, attention is drawn to the fact that methods for diagnosing and modeling an enterprise's economic processes are fundamental to improving the effectiveness of managerial decisions [1; 6-7]. These methods enable timely responses to changes, forecasting of their consequences, and the selection of effective management action plans.

Most researchers note that this is associated with their high level of responsiveness (see Fig. 1), which is manifested, in particular, in the following aspects:

- a focus on the rapid detection of changes (*Shmatkovska T., Dzyamulych M., and Stashchuk O. [7]*);
- a focus on generating results based on available data and specific user requests (*Stanislavik O., Kovalenko O., and Zhao J. [6]*);
- a focus on ensuring the timeliness of information flows (*Ughulu J. [4]*);
- a focus on rapid evolutionary adaptability (*Shmatkovska T., Dzyamulych M., and Stashchuk O. [7]*).

Characteristics: Involves prompt response to deviations from planned indicators.

Focus on generating results based on available data and managerial requests
Characteristics: Involves adapting conclusions to specific informational needs.

The combination of these focal points is intended to enable the methods to respond promptly to changes, assess the consequences of those changes, and adjust managerial decisions in accordance with the requirements of the management system.

Focus on ensuring the timeliness of the information flow

Characteristics: Involves the rapid delivery of data necessary for decision-making.

Focus on rapid evolutionary adaptation of models to new conditions and challenges

Characteristics: Involves the ability to quickly modify models in response to new circumstances.

Fig. 1. Characteristics of the responsiveness of methods for diagnosing and modeling economic processes

Source: created by the authors based on [2-3; 5-6]

In particular, we interpret the diagnosis of economic processes as a systematic examination and assessment of an enterprise's financial and operational activities, aimed at identifying problems, determining opportunities for efficiency improvement, and supporting well-founded managerial decisions. Consequently, its outcome should provide objective information on the enterprise's financial condition, productivity levels, resource utilization efficiency, and internal development reserves [2-3; 7].

This is achieved using methods such as (see Table 1): financial analysis (balance sheet and income statement analysis, ratio analysis), economic and statistical methods (correlation and regression analysis, trend analysis), expert evaluations, and business process modeling through software tools for forecasting and optimizing enterprise operations.

Indeed, financial analysis (including balance sheet analysis, income statement analysis, and ratio analysis) is classically used to assess an enterprise's financial condition, determining its liquidity, profitability, and solvency. However, within the context of diagnosing economic processes, these methods take on greater practical significance, as they enable the identification of problematic areas in financial operations, the evaluation of resource utilization efficiency, and the detection of opportunities for improving productivity and profitability.

Table 1. Description of methods for diagnosing an enterprise's economic processes

Main groups of diagnostic methods	Primary purpose of the method	Description of the method in diagnosing economic processes	Expected outcome from applying the diagnostic methods
Financial analysis	Assessing the enterprise's financial condition	Analysis of the balance sheet and income statement, ratio analysis (liquidity, profitability, financial stability)	Identification of financial strengths and weaknesses, determination of solvency and profitability
Economic-statistical methods	Identifying patterns and trends in company operations	Correlation and regression analysis, trend analysis, construction of time series	Forecasting the development of economic processes, identifying factors affecting efficiency
Expert evaluations	Obtaining qualitative assessments of economic processes	Expert surveys, rating scales, Delphi method	Forming an objective understanding of internal reserves, risks, and development prospects

Source: created by the authors based on [2-3; 5-6]

The informativeness of financial analysis depends on the specific characteristics of each method [5-6]:

- Balance sheet analysis provides systematic information on surpluses or shortages of current assets, as well as on the enterprise's solvency and overall financial stability.
- Income statement analysis offers a structured breakdown of expense items that have the most significant impact on financial results, facilitating the identification of opportunities to improve profitability.
- Income statement analysis offers a structured breakdown of expense items that have the most significant impact on financial results, facilitating the identification of opportunities to improve profitability.

Economic and statistical methods—such as correlation and regression analysis, trend analysis, and time series construction—are traditionally used to analyze large datasets and identify patterns, relationships, and trends across various areas of the economy. In the context of diagnosing economic processes, these methods are intended to assess the impact of individual factors on an enterprise's operational

efficiency, forecast the development of economic processes, and identify internal reserves for improving productivity and profitability.

The informativeness of these methods is determined by their particular characteristics [1; 6]:

- Correlation analysis provides systematic information on the relationships between different economic indicators (for example, between material costs and production volume), allowing the identification of factors that most significantly affect company efficiency.
- Regression analysis delivers structured information for quantitatively evaluating the influence of specific factors on performance indicators.
- Trend analysis and time series construction offer systematic insights into long-term tendencies in financial, production, or market indicators, enabling timely adjustments to both strategic and operational plans.

Group of expert-based methods—including expert surveys, rating scales, and the Delphi method—is traditionally employed to obtain qualitative assessments of complex phenomena that are difficult to formalize using quantitative approaches, particularly in areas such as management, risk management, and strategic planning [1; 5-6]. In the context of diagnosing economic processes, these methods are used to evaluate the efficiency of an enterprise's internal operations, identify development reserves and potential risks, and provide an objective basis for managerial decision-making under conditions of uncertainty.

For example, the Delphi method enables a panel of experts to evaluate the likelihood of success for a strategic project, identify weaknesses in production or financial processes, and recommend optimal strategies to improve the enterprise's operational efficiency.

Overall, the application of diagnostic methods in economic processes provides a foundation for improving the quality of managerial decisions and ensuring the sustainable development of the enterprise.

In turn, the modeling of economic processes is interpreted by the authors as their cyclical reproduction through a system of economic indicators using various

models—analytical, mathematical, simulation, or computer-based—with the aim of evaluating efficiency, forecasting the outcomes of managerial decisions, and optimizing resource utilization. Accordingly, the results of such modeling provide a wide range of possibilities for predicting the consequences of managerial actions. These objectives are achieved through methods such as those presented in Table 2: analytical modeling, mathematical modeling, simulation modeling, and computer-based modeling [7].

Table 2. Description of methods for modeling an enterprise’s economic processes

Main groups of modeling methods	Primary purpose of the method	Description of the method in modeling economic processes	Expected outcome from applying the modeling methods
Analytical modeling	Establishing logical and mathematical relationships between indicators	Use of formulas, relationships, and models to describe economic processes	Predictability of managerial decision outcomes and process efficiency parameters
Mathematical modeling	Quantitative analysis of economic processes	Application of algebraic, differential, or stochastic methods to describe the interrelationships of indicators	Predictability regarding the variability of influencing factors, supporting strategic planning
Simulation modeling	Assessing process dynamics and development scenarios	Creation of computer models (e.g., in AnyLogic, Simul8) to replicate production, financial, or logistical processes	Predictability of managerial decision outcomes, optimization of production and resource flows, risk reduction
Computer-based modeling	Data integration and real-time forecasting	Use of software tools for process analysis, automation of calculations, and forecasting results	Support for managerial decisions, identification of ways to improve enterprise efficiency and adaptability

Source: created by the authors based on [1; 3-4; 7]

The group of methods for analytical modeling of an enterprise’s economic processes is used for the systematic description of economic phenomena and the interrelationships between performance indicators through formulas, equations, and logical dependencies. These methods are highly versatile, as they allow for [1]:

1. Quantitative assessment of the efficiency of individual economic processes;

2. Forecasting the outcomes of managerial decisions based on analytical models;
3. Identifying factors that have the greatest impact on the enterprise's productivity, profitability, and financial stability;
4. Formulating well-founded recommendations for the optimization of resources and processes.

For example, using an analytical model to assess the impact of changes in product cost and material expenses on an enterprise's net profit enables management to make well-founded adjustments to production and pricing policies.

The group of methods for mathematical modeling of an enterprise's economic processes is used for the systematic visualization of interrelationships between economic indicators, enabling precise identification of operational efficiency and optimization of managerial decisions. From a practical perspective, these methods allow for [1; 3; 7]:

1. Visualizing cause-and-effect relationships between resources, costs, and production outcomes;
2. Visualizing the development of economic processes under different scenarios of external and internal changes;
3. Visualizing optimal ways to utilize financial, material, and labor resources;
4. Creating systems to support well-founded strategic and operational managerial decisions.

The group of methods for simulation modeling of an enterprise's economic processes is used to replicate the dynamics of production, financial, and managerial processes in the form of computer models, with the aim of evaluating different development scenarios and forecasting the outcomes of managerial decisions. From a practical perspective, these methods allow for [3-4]:

1. Replicating the operation of production, managerial, and service processes in a virtual environment to analyze their behavior in real time;
2. Assessing the impact of changes in equipment schedules, personnel allocation, or financial resources on overall enterprise efficiency;

3. Forecasting the consequences of various strategic and tactical decisions without the risk of losses in real-world conditions;
4. Identifying and testing internal reserves to enhance productivity and profitability.

For example, a simulation model of a production line, created using software such as AnyLogic or Simul8, allows for a visual demonstration of how changes in equipment schedules or personnel allocation affect production volume and machine downtime.

The group of methods for computer-based modeling of an enterprise's economic processes is employed for data integration, automation of calculations, and forecasting the outcomes of managerial decisions using specialized software. From a practical standpoint, these methods enable [7]:

1. The creation of comprehensive models of economic processes that incorporate a wide range of factors and variables;
2. Real-time analysis and optimization of business processes;
3. Forecasting the effects of managerial decisions and assessing the efficiency of resource utilization;
4. Supporting strategic and operational planning by providing management with reliable information for decision-making.

For example, the use of an ERP system or specialized software for modeling financial and production flows enables enterprise management to assess the impact of changes in sales volumes, raw material costs, or logistical decisions on overall performance and to adjust strategy in a timely manner.

The result of modeling is the creation of a broad range of possibilities for forecasting the consequences of managerial decisions [1; 7].

At the same time, the combination of diagnostic and modeling methods into a unified methodological system is particularly important, as it maximizes the quality of managing an enterprise's economic processes [2; 4]. The main characteristics of integrating diagnostic and modeling methods include

comprehensiveness, cyclicality and feedback, as well as standardization and systematicity.

Conclusions. It has been substantiated that the application of a set of diagnostic methods—including financial analysis, economic and statistical methods, and expert evaluations—provides the formation of an objective informational basis for managerial decision-making. Meanwhile, methods for modeling economic processes—analytical, mathematical, simulation, and computer-based modeling—enable the replication of an enterprise's economic processes, forecasting the consequences of managerial actions, and optimizing resource utilization.

The study has demonstrated that integrating diagnostic and modeling methods into a unified methodological system enhances the quality of managing an enterprise's economic processes by ensuring the timely identification of problem areas, the assessment of internal development reserves, and the generation of alternative managerial decision scenarios. It has further been shown that the comprehensive application of these methods contributes to increasing the enterprise's adaptability to changes in the external environment, reducing managerial risks, and improving the efficiency of financial and operational activities.

The findings can be applied in the management of enterprises across various industries to improve systems of economic analysis, strategic and operational planning, and may also serve as a basis for further research on developing integrated models for diagnosing and modeling an enterprise's economic processes.

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